Three new early-flowering species of *Petrophile* (Proteaceae) from south-western Australia

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Abstract

M. Hislop & B.L. Rye. Three new early-flowering species of *Petrophile* (Proteaceae) from south-western Australia. *Nuytsia* 14(3): 365–374 (2002). Three new south-western Australian species, *Petrophile antecedens* Hislop & Rye, *P. clavata* Hislop & Rye and *P. nivea* Hislop & Rye, are described and illustrated. All of these species show similarities to, and one of them has been included under, *P. brevifolia* Lindl. The relevant part of the key to *Petrophile* in "Flora of Australia" Volume 16 is updated to include the new species and other new information. All of the new species have an early flowering time and two of them have conservation priority.

Introduction

Petrophile R. Br. ex Knight (Proteaceae) is a genus of at least 57 species, with one species endemic to Kangaroo Island in South Australia, five species endemic to eastern Australia, and the remainder endemic to south-western Australia. The genus was treated for "Flora of Australia" by Foreman (1995), who has named 11 new species.

An additional three new species of *Petrophile*, including one not discovered until 1999 when it was collected for the first time south of Encabba, are described in this paper. A common factor that appears to have hindered the discovery of each of these species is their early flowering period. All three could be confused with *P. brevifolia* Lindl., as they key out more closely to that species than to any other in Blackall & Grieve (1988) and in Foreman (1995), but are readily distinguished by a number of morphological differences. A portion of the key to *Petrophile* in "Flora of Australia" key is revised to incorporate the new taxa.

Methods

All measurements were taken from dry pressed material. Measurements of the tepal limb were taken from the point of insertion of the very short filament of the stamen to the apex of the tepal and did not include the hairs extending beyond the apex. Anther length was taken from newly dehisced anthers and included the length of the sterile tip, i.e. the terminal extension of the connective. The pollen presenter was measured from the point near the end of the style where the thickening begins to the apex of the small terminal stigma. The hairy portion of the presenter is referred to here as the 'brush'.

Distribution maps were obtained from the Western Australian Herbarium's Florabase data. Biogeographic regions are as defined in Thackway & Cresswell (1995). The conservation codes given in this paper are those used by the Western Australian Department of Conservation and Land Management. An explanation of these codes is given at the end of this *Nuytsia* issue.

Update to "Flora of Australia" treatment of *Petrophile*

Circumscription of *Petrophile brevifolia* Lindl.

The description of *Petrophile brevifolia* given by Foreman (1995) in "Flora of Australia" Volume 16 agrees fairly well with our circumscription of the species. Both the branchlets and cone scales are described as glabrous, excluding two of the new species. The third new species, *P. nivea*, is excluded by the description of the cones as being 10–20 mm long. However, the description of the flower colour as "yellow or cream or white" should be amended to "pale yellow or cream" as the tepals of *P. brevifolia* are not pure white as in *P. nivea*.

Petrophile brevifolia is a very variable taxon in need of further study. Although most of its variants flower from August to December, there is at least one early-flowering variant that may begin flowering in June and therefore overlap in flowering time with the new species described below.

Revision of key

To bring it up to date with this study, the key to species of *Petrophile* given in Volume 16 of "Flora of Australia" needs to be amended after the second lead of the fifth couplet on page 150. A revision of that portion of the key is given below. Addition of the new taxa requires four new couplets, A–D, to be used. Some characters used in the original key that give an incomplete separation of the taxa have been deleted. New characters have been added in places, for example to couplet 8, and distribution data have also been added.

Note that in couplet 14 of the original key *Petrophile teretifolia* R. Br. was incorrectly given instead of *P. brevifolia*, which should key out for the second time at that point. *P. teretifolia* always has leaves much longer than 15 mm and is correctly keyed earlier in the original key.

Another species for which significant changes have been incorporated into the key below is *Petrophile longifolia* R. Br. The circumscription of *P. longifolia* in "Flora of Australia" encompasses two main taxa, one with prostrate stems as illustrated by a photograph (Figure 29), and the other with stems more erect as illustrated in Figure 94H. The prostrate taxon is probably a new species and is currently known in PERTH by the informal name *Petrophile* sp. prostrate (*J.W. Horn & R. Butcher* 2649). It extends from the Stirling Range area to the south coast, extending east to Hopetoun, and its pollen presenter has the base somewhat compressed and a very dense brush with clubbed hairs. The taxon assumed to be true *P. longifolia* is more widespread; its pollen presenter has a base that is not compressed and a dense brush with acute hairs. Type material of *P. longifolia* has been requested to resolve this uncertainty as to the true identity of the taxon.

Petrophile longifolia also needs to key out under the second lead of couplet 3, as it sometimes has the leaves minutely scabrous. It would key out there with *P. aspera* C.A. Gardner ex Foreman, from which it can be distinguished by its less prominently scabrous leaves and its longer pollen presenter with the swollen base distinctly wider than the bottom of the brush.

5: Cones and inflorescence sessile
7 Most leaves more than 15 mm long
8 Leaves terminating in a pungent point 1–2.5 mm long; brush of pollen presenter not very dense, the axis clearly visible
A Involucral bracts densely hairy on base, the glabrous portion brown outside; pollen presenter with clubbed hairs
B Pollen presenter 1.5–2.2 mm long, the swollen portion more or less fusiform and partially hairy, the glabrous base about as long as the brush; involucral bracts prominent, conspicuously brown above the grey-hairy base. (York area to Darkan area and Harrismith.) ..... **P. antecedens**
B: Pollen presenter 3–4 mm long, the swollen portion very narrowly turbinate, glabrous and much longer than the cylindrical brush above; involucral bracts not prominent, with the brown apex more slender than in B above and not conspicuous above the grey-hairy base. (Coorow to Calingiri.) ..... **P. clavata**
A: Involucral bracts glabrous, grey throughout or with grey margins; pollen presenter with acute hairs
9 Involucral bracts very narrowly ovate; tepals 12–20 mm long. (Shark Bay to Perth to near Ravensthorpe.) ..... **P. brevifolia**
9: Involucral bracts ovate or almost elliptic; tepals *c.* 30 mm long. (Mullewa to near Watheroo.) ..... **P. megalostegia**
8: Leaves blunt or acute, but without a prominent pungent point; brush of pollen presenter dense or very dense (with the axis hidden) in all species except *P. media*
10 Tepals mauve or pink turning whitish; brush of pollen presenter *c.* 3 mm long, with clavate hairs. (Stirling Range to Israelite Bay.) ..... **P. teretifolia**
10: Tepals cream or yellow; brush of pollen presenter *c.* 2 mm long, with acute or clavate hairs.
11 Cone scales very prominently striate; tepals *c.* 10 mm long; brush hairs (except for the basal ones) with a recurved apex. (Scott River to Two Peoples Bay.) ..... **P. acicularis**
11: Cone scales not very prominently striate; tepals 15–25 mm long; brush hairs with apex patent or incurved.
12 Involucral bracts usually 20–40, grey throughout or brown with grey margins; cone scales narrowly ovate or ovate; pollen presenter brush moderately dense, with portions of the axis visible, the upper hairs antrorse and straight. (Darling Range to Scott River to Ravensthorpe.) ..... **P. media**
12: Involucral bracts usually 8–20, brown; cone scales ovate to broadly rhomboid; pollen presenter brush dense or very dense, the axis largely or fully hidden, the upper hairs either ascending and incurved or patent.
C Stems prostrate on mature plants; pollen presenter with no indentation at summit of swollen base, the basal hairs patent, all hairs obtuse to distinctly clubbed. (Stirling Range area to Manypeaks to Hopetoun.) ..... **P.** sp. **prostrate**

C: Stems more erect; pollen presenter with the basal hairs usually strongly antrorse so as to give the appearance of a constriction between the base and the brush, all hairs acute or rarely basal ones obtuse. (Wandering to Perup River to Albany and Stirling Range area.) ..... **P. longifolia**

7 Most leaves 6–15 mm long

13 Tepals glabrous. (Hyden to Stirling Range to Israelite Bay.) ..... **P. phylicoides**

13: Tepals villous

14 Leaves with a pungent point 0.5–2.5 mm long; pollen presenter with a truncate to narrowly obovoid glabrous base and terete upper axis, with hairs restricted to the terete portion.

D Leaves sufficiently distant not to conceal the branchlets and involucral bracts; involucral bracts grey throughout or brown with grey margins; tepals cream or pale yellow, the limb with hairs 0.5–0.8 mm long; cones 10–20 mm diam. (Shark Bay to Perth to near Ravensthorpe.) ..... **P. brevifolia**

D: Leaves very crowded, concealing the branchlets and involucral bracts; involucral bracts brown throughout; tepals white, the limb with hairs 1–1.5 mm long; cones 6–8 mm diam. (Near Eneabba.) ..... **P. nivea**

14: Leaves with a broad mucro at apex, not pungent; pollen presenter largely fusiform, with hairs on all but the base of the fusiform swelling. (Southern Cross to Coolgardie to Peak Charles.) ..... **P. arcuata**

Descriptions of new species

Petrophile antecedens Hislop & Rye, *sp. nov.*

Frutex ramulis pilosis. Folia teretia, pungentia. Inflorescentia sessilis, globosa; bracteae involucrales manifestae, peranguste ovatae, fusae, basi pilosae. Tepala pallido-cremea, dense pilosa. Pollinis praebitor tumore plus minusve fusiformi praeditus, cujus pars superior pilis manifeste clavatis.

Typus: 3.5 km east of Metro Rd then north on the track for 1.65 km, Gibbs State Forest, Wandering, Western Australia, 1 June 2000, *F. Hort* 1037 (*holo:* PERTH 05570530; *iso:* CANB).

Shrub erect, often widely spreading, 0.3–0.5 m high, up to 0.5 m wide, without a lignotuber. *Branchlets* hairy, conspicuously so on young growth. *Leaves* antrorse, almost straight to distinctly recurved, those directly below the inflorescences mostly distinctly recurved, simple, terete, 20–40 x 1–2 mm, with a pungent apical point; point straight or very slightly recurved, 1–2 mm long. *Inflorescence* terminal, sessile, globose, 20–30 mm diam. *Involucral bracts* numerous, conspicuous, often recurved, very narrowly ovate, 14–25 mm long, acuminate, densely hairy and appearing greyish towards base, glabrous and brown above. *Cone scales* narrowly ovate or ovate, 7–12 mm long, densely hairy outside throughout or at least on distal half. *Tepals* 10–15 mm long, pale cream, with a very dense indumentum of patent to antrorse hairs; limb 1.6–2 mm long, lacking a pronounced apical point, the largest hairs 1–2 mm long. *Anthers c.* 1.3 mm long; sterile apex *c.* 0.25 mm long. *Pollen presenter* 1.5–2.2 mm long, yellow turning reddish brown, the swollen portion very narrowly obovoid, almost fusiform, i.e. the apex tapering to the brush axis, which is broader at the base than at the apex, the glabrous tip 0.2–0.4 mm long;

brush 0.8–1.2 mm long, 0.5–0.7 mm diam., the axis moderately densely covered by clavate hairs 0.2–0.3 mm long but still visible between the hairs. *Cones* very broadly ovoid or globose, 12–15 x 10–13 mm. *Nuts* very broadly or depressed obovate in outline, with a slightly indented base, beaked, *c.* 3 x 3–3.5 mm not including the beak or hairs; adaxial surface densely covered by dark purplish hairs *c.* 0.3 mm long and with scattered long golden hairs on the surface, very densely hairy on the margin with golden brown (sometimes also some white) hairs, the larger ones 4–4.5 mm long; abaxial surface largely glabrous apart from a central band of white appressed hairs or sometimes completely glabrous. (Figure 1 A–C)

Other specimens examined. WESTERN AUSTRALIA: off Dardadine Rd South, NE of Stricklands Rd, SE of Dardadine, 18 May 1992, *V. Crowley* DKN 128 (PERTH); Harrismith, 15 July 1993, *D. Greeve* (ALB); along a track off Deefor Rd, *c.* 2.5 km S of Pine Plot 6, Flynn State Forest, W of York, 8 June 2000, *F. Hort* 1043 (PERTH); *c.* 0.8 km NE of Deefor Rd on a track originating 5.9 km E of Yarra Rd and 1.4 km W of Bumper Rd, Flynn State Forest, W of York, 8 June 2000, *F. Hort* 1044 (PERTH); along a track off Deefor Rd, *c.* 2.5 km S of Pine Plot 6, Flynn State Forest, 31 July 2000, *F. Hort* 1094 (PERTH); Deefor Rd, 0.6 km W of Nuytsia Rd then *c.* 200 m NW, Flynn State Forest, 13 Sep. 2000, *F. Hort* 1125 (PERTH); Narrakine Rd, S of gravel reserve, 29 May 1999, *C. Taylor, P. Rose & G. Warren* 214 (PERTH); Narrakine Block State Forest 52, S side, 20 May 1999, *G. Warren* 233 (PERTH).

Distribution and habitat. Distributed in the Avon Wheatbelt and Jarrah Forest regions of the South West Botanical Province, occurring in an area about midway between Canning Dam and York and extending south to Dardadine (which is near Darkan) and south-east to Harrismith. The species occurs mainly in open woodlands of Jarrah, Marri, Wandoo or other eucalypts, but one population is known from dense heathland surrounded by woodland. The soil has been recorded as white or yellowish sandy clay soils, sometimes mixed with gravel, and overlying laterite. (Figure 2)

Phenology. Flowers May to early June. This species has a particularly brief and early flowering period in comparison with other members of the genus.

Conservation status. Although only recently discovered, with the first known collection made in 1992, this taxon is not considered to be at risk. Several new large populations were located in surveys by Fred Hort in 2000. The known range of the species is *c.* 170 km long and 100 km wide.

Etymology. From the Latin *antecedens* – preceding, as this species flowers ahead of nearly all other members of the genus *Petrophile*.

Notes. See notes under its closest relative *Petrophile clavata*. Four other species that are similar in having clavate hairs on the pollen presenter are *P. aspera*, *P. helicophylla* Foreman, *P.* sp. prostrate (*J.W. Horn & R. Butcher* 2649) and *P. teretifolia*, but in these species the hairs are less prominently clavate and are more densely arranged. These four species all appear to be more closely related to one another than to *P. antecedens* and *P. clavata*.

Petrophile clavata Hislop & Rye, *sp. nov.*

Petrophile antecedens affinis sed pollinis praebitore grandiore basi glabro anguste turbinato, longitudine penicillum cylindraceum multo superante, bracteis involucralibus magis pilosis, minus conspicuis et acumine graciliore differt.

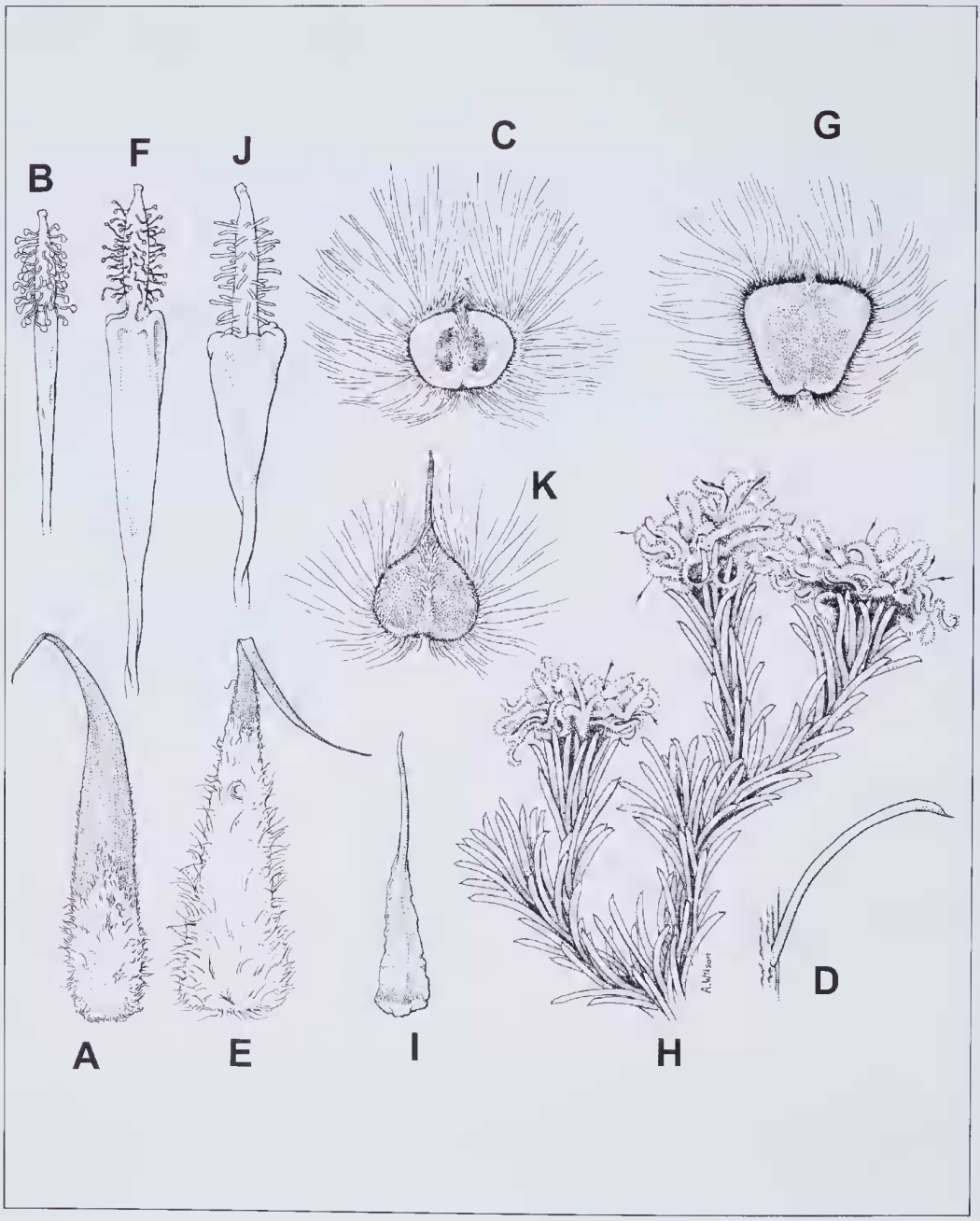

Figure 1. A–C. *Petrophile antecedens*. A – involucral bract (x4), B – pollen presenter (x15), C – abaxial surface of nut (x4.5); D–G. *Petrophile clavata*. D – leaf (x2), E – involucral bract (x4), F – pollen presenter (x15), G – abaxial surface of nut (x6); H–K. *Petrophile nivea*. H – flowering branch (x1), I – involucral bract (x4), J – pollen presenter (x15), K – abaxial surface of nut (x6). Drawn by Annemarie Wilson from *F. Hort* 1037 (A–C), *A.S. George* 16303 (C–F), *C. Chapman s.n.* (G) and *M. Hislop* 1341 (H–K).

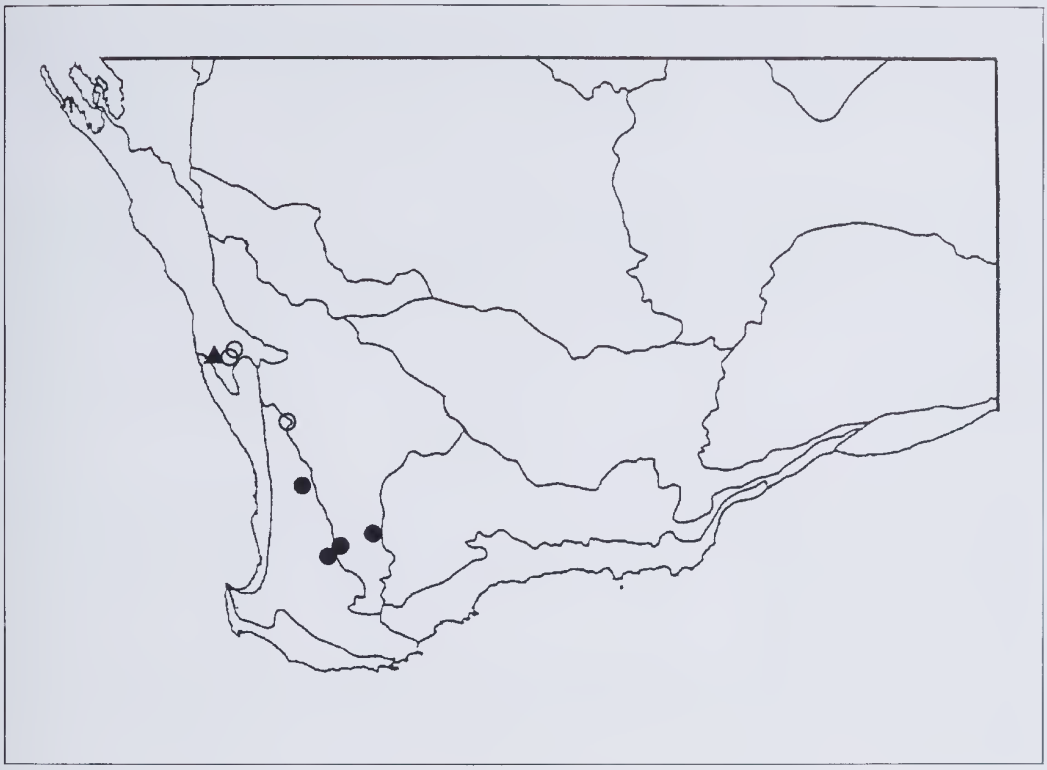

Figure 2. Distributions of *Petrophile antecedens* ●, *P. clavata* ○ and *P nivea* ▲ in south-western Australia.

Typus: 9 km south-west of Calingiri, 1 June 1984, Western Australia, *A.S. George* 16303 (*holo:* PERTH 03422712; *iso:* MEL *n.v.*).

Shrub erect or spreading, 0.25–0.7 m high. *Branchlets* hairy, conspicuously so on young growth. *Leaves* antrorse, sometimes mostly almost straight to incurved or s-shaped but usually mostly distinctly recurved, simple, terete, 20–50 x 1–2 mm, with a pungent apical point; point straight or very slightly recurved, 1–2 mm long. *Inflorescence* terminal, sessile, globose, 30–45 mm diam. *Involucral bracts* numerous, often recurved, very narrowly ovate, 10–20 mm long, narrowly acuminate, densely hairy and grey on base, somewhat hairy above then glabrous and brown distally. *Cone scales* narrowly ovate or ovate, 7–12 mm long, densely hairy outside throughout or at least on distal half. *Tepals* 15–20 mm long, cream or very pale yellow, with a very dense indumentum of patent to antrorse hairs; limb 2.2–2.5 mm long, lacking a pronounced apical point, the largest hairs usually 1.5–2 mm long. *Anthers* at least 1.5 mm long (only old ones seen). *Pollen presenter* 3–4 mm long, colour not clear but probably yellow turning red-brown, the glabrous base very narrowly obconic (i.e. the apex truncate), the brush axis uniform in diameter, the glabrous tip *c.* 0.2 mm long; brush 1–1.2 mm long, 0.5–0.7 mm diam., the axis fairly densely covered by clavate hairs 0.2–0.3 mm long but still visible between the hairs. *Cones* globose or depressed globose, 10–12 x 10–15 mm. *Nuts* broadly or very broadly obovate in outline, with a slightly indented base, shortly beaked, *c.* 3.3 x 3.5 mm not including the beak or hairs; adaxial surface densely covered by dark purplish hairs *c.* 0.15 mm long and with a few long golden hairs on the surface, very densely hairy on the margin with golden brown hairs, the larger ones 3–3.5 mm long; abaxial surface glabrous apart from a central band of white appressed hairs. (Figure 1 D–G)

Other specimens examined. WESTERN AUSTRALIA: Coorow Reserve, W of Coorow, 30 June 1967, *C. Chapman* (PERTH); 9 km SW of Calingiri, 1 June 1984, *A.S. George* 16302 (MEL *n.v.*, PERTH); vacant crown land immediately S of Alexander Morrison National Park, 7 Sep. 1979, *E.A. Griffin* 2199 (PERTH).

Distribution and habitat. Collected in Coorow Reserve, adjacent to Alexander Morrison National Park and near Calingiri. Two of these localities are in the Geraldton Sandplains region not far from the border of the Swan Coastal Plain region, while the third locality is more or less on the border between the Avon Wheatbelt and Jarrah Forest regions. *Petrophile clavata* may well occur in all four of these biogeographic regions. It is recorded in heathland vegetation, in sandy soils on laterite hilltops. (Figure 2)

Phenology. Flowers: probably May to July or August. No young inflorescences have been seen, the specimens collected at the beginning of June having all flowers fully opened and the other specimens having only old inflorescences with flowering completed.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. Currently known from three localities extending over a distance of *c.* 140 km and including at least one reserve. This species is in need of further survey to determine its conservation status more accurately. It is probably poorly collected partly because of its early flowering time.

Etymology. From the Latin *clavatus* – clubbed, referring to the clavate hairs on the pollen presenter. The clubs on the pollen presenter are more obvious in this species (Figure 1B) than any of the other five species of *Petrophile* known to have clavate hairs, including its very close relative *P. antecedens* (Figure 1F).

Notes. There are no records as to whether or not this taxon has a lignotuber.

Petrophile clavata occurs within the geographic range of the much more common and variable species *P. brevifolia* and was previously included under that species. It is not known whether the two species coexist at any localities, but even if they do coexist they may still be completely reproductively isolated, as they would be unlikely to flower simultaneously. *P. clavata* can be readily distinguished from *P. brevifolia* by the presence of a conspicuous indumentum on the branchlets, involucral bracts and cone scales. Other differences include the longer hairs on the tepals, the longer base to its pollen presenter (always considerably longer than the brush) and the clubbed hairs on the brush.

The closest relative of *Petrophile clavata* is one of the other new species, *P. antecedens*. In addition to the differences given in the key, *P. clavata* has larger inflorescences than *P. antecedens*. Floral measurements such as tepal and anther length appear to be greater in *P. clavata* but cannot be accurately measured in this species since there are no young flowers on the specimens. The two taxa appear to be geographically separated, although further survey is needed to determine their full ranges. They also appear to show significant habitat differences, with *P. clavata* recorded from more open, exposed locations in heathlands on lateritic hills and certainly occurring in a less humid environment than that of *P. antecedens*, which occurs in woodlands (or less commonly in dense heathlands) and not on the highest ground.

Petrophile nivea Hislop & Rye, *sp. nov.*

Frutex erectus, ramulis glabris. Folia congesta, teretia, pungentia. Inflorescentia sessilis, globosa;

bracteae involucrales a foliis occultae, peranguste ovatae, fuscae, glabrae. Tepala nivea, dense pilosa. Pollinis praebitor basi peranguste turbinatus, glaber, supra pilis brevibus acutis sparse obtectus.

Typus: in the locality of Warradarge, south of Eneabba [precise locality withheld], Western Australia, 9 July 1999, *M. Hislop* 1341 (*holo:* PERTH 05372682; *iso:* CANB, K, MEL).

Shrub 0.4–0.6 m high, commonly 0.3–0.4 m wide, without a lignotuber. *Branchlets* glabrous. *Leaves* widely to shallowly antrorse, crowded, largely concealing the surfaces of the branchlets and involucral bracts, simple, gently s-shaped, incurved or recurved, terete, 10–15 x 1–1.5 mm, with a slightly recurved apex including a point, glabrous; point pungent, 0.5–1 mm long, brown. *Inflorescence* terminal, sessile, globose, 20–25 mm diam. *Involucral bracts* few, erect, very narrowly ovate, 8–12 mm long, acuminate, brown throughout, glabrous. *Cone scales* narrowly ovate, 5–7 mm long, glabrous apart from a few marginal hairs. *Tepals c.* 15 mm long, white, with a very dense indumentum of patent to antrorse hairs; limb 3–4 mm long including a pronounced apical point 0.6–1 mm long, the largest hairs 1–1.5 mm long. *Anthers c.* 1.7 mm long; sterile apex *c.* 0.2 mm long. *Pollen presenter* 2–3 mm long, yellow turning reddish brown, glabrous on the narrowly obconic basal swelling 0.8–1.2 mm long and on the apical tip 0.3–0.4 mm long; brush 1–1.4 mm long, *c.* 0.5 mm diam., the axis rather sparsely covered by acute hairs *c.* 0.2 mm long. *Cones* globose, 6–8 x 6–8 mm. *Nuts* broadly ovate-cordate in outline, prominently beaked, *c.* 3 x 2.5 mm not including the beak; adaxial surface with a dense indumentum of minute dark hairs and with scattered long white hairs on the surface, very densely hairy on the margin with white hairs, the largest ones 3–4 mm long; abaxial surface with a prominent central band of white appressed hairs and similar hairs scattered elsewhere. (Figure 1 H–K)

Other specimen examined. WESTERN AUSTRALIA: type locality, 29 May 1999, *M. Hislop* 1308 (PERTH).

Distribution and habitat. Known from a single locality to the south of Eneabba, in the Geraldton Sandplains region. The species grows on white sand over laterite in a heathland that is very rich in Proteaceae, including ten other species of *Petrophile*. The associated *Petrophile* species are *P. aculeata* Foreman, *P. brevifolia*, *P. chrysantha* Meisn., *P. linearis* R. Br., *P. macrostachya* R. Br., *P. megastegia* F. Muell., *P. scabriuscula* Meisn., *P. serruriae* R. Br., *P. shuttleworthiana* Meisn. and *P. striata* R. Br. (Figure 2)

Phenology. Flowers: May to August.

Conservation status. Conservation Codes for Western Australian flora: Priority One. Currently known only from the type locality on private property, where it is locally common.

Etymology. From the Latin *niveus* – snow-white, referring to the flower colour.

Notes. A distinctive species characterised by its pure white flowers, crowded leaves largely concealing the surfaces of the branchlets and involucral bracts, long perianth hairs and small cones. Also notable is its dense zigzag growth pattern, with seasonal growth increments short and produced at a wide angle (*c.* 45 degrees) from the terminal point of the previous season's growth. These characters readily distinguish *P. nivea* from the ten other *Petrophile* species with which it coexists at the type locality. The coexisting species include *P. brevifolia*, which appears to be its closest relative, but the earlier flowering time of *P. nivea* apparently prevents any possiblity of hybridisation.

Acknowledgements

We would like to thank Fred Hort for collecting specimens of one of the new species, Paul Wilson for translating the diagnoses into Latin and Annemarie Wilson for the excellent line illustration.

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